

June 1994



Chemistry 30

Grade 12 Diploma Examination

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Multiple Choice Questions

June 1994

Chemistry 30

Grade 12 Diploma Examination

Description

Time allotted: 2.5 h. You may take an additional 0.5 h to complete the examination if needed.

Total possible marks: 70

This is a **closed-book** examination consisting of **three** parts:

Part A

has 42 multiple-choice questions each with a value of one mark.

Part B

has 7 numerical-response questions each with a value of one mark.

Part C

has 3 written-response questions for a total of 21 marks.

A chemistry data booklet is provided for your reference.

Instructions

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Carefully read the instructions for each part before proceeding.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Do not fold the answer sheet.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.*

APPENDIX
M. QUALITY
ASSESSMENT

1. Quality Assessment

Quality assessment is the process of evaluating the quality of a product or service. It is a systematic process of determining whether a product or service meets the requirements of the customer or user.

Quality assessment is often used to evaluate the performance of a product or service.

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Part A: Multiple Choice (42 Questions)

Instructions

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully and decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This diploma examination is for the subject of

- A. biology
- B. physics
- C. chemistry
- D. mathematics

Answer Sheet

(A) (B) (C) (D)

- Use an HB pencil only.
- If you wish to change an answer, erase **all** traces of your first answer.

Note: The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.

Do not turn the page to start the examination until told to do so by the presiding examiner.



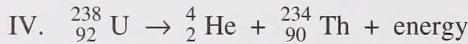
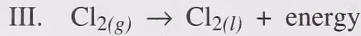
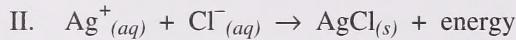
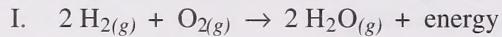
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1. Incoming energy is converted mainly into potential energy when
 - A. $\text{H}_2\text{O}_{(s)}$ is warmed from -20°C to 0°C
 - B. $\text{H}_2\text{O}_{(l)}$ is warmed from 0°C to 100°C
 - C. $\text{H}_2\text{O}_{(g)}$ is warmed from 100°C to 150°C
 - D. $\text{H}_2\text{O}_{(l)}$ is vapourized at 100°C
2. If 200 kJ of heat energy were transferred to a substance and 25.0 kJ of this heat were used to cause a change of the state of the substance, how much heat did the substance absorb as kinetic energy?
 - A. 225 kJ
 - B. 200 kJ
 - C. 175 kJ
 - D. 25.0 kJ
3. Which reaction is a standard formation reaction for a compound?
 - A. $\text{CH}_4_{(g)} + 2 \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(l)}$
 - B. $\text{Ca(OH)}_2_{(aq)} + 2 \text{Na}_{(s)} \rightarrow \text{Ca}_{(s)} + 2 \text{NaOH}_{(aq)}$
 - C. $\text{H}_2\text{O}_{(g)} \rightarrow \text{H}_2\text{O}_{(l)}$
 - D. $2 \text{Na}_{(s)} + \text{O}_{2(g)} + \text{H}_{2(g)} \rightarrow 2 \text{NaOH}_{(s)}$
4. An exothermic reaction may be defined as a reaction in which
 - A. the ΔH value is positive
 - B. energy is released by the reaction
 - C. energy is absorbed from the surroundings
 - D. the energy is written on the reactant side of the equation

5. Which of these processes is exothermic?

- A. The freezing of water
- B. The vapourization of water
- C. The sublimation of dry ice
- D. The boiling of liquid nitrogen

Use the following equations to answer question 6.



6. Which statement about these equations is **false**?

- A. II is a phase change.
- B. I is a chemical reaction.
- C. All the equations are exothermic.
- D. The heat content of the products is less than that of the reactants in all four equations.

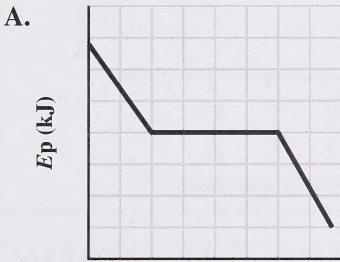
7. A group of students are interested in determining experimentally the molar heat of reaction of wax with oxygen. Their experiment should be based upon the processes of

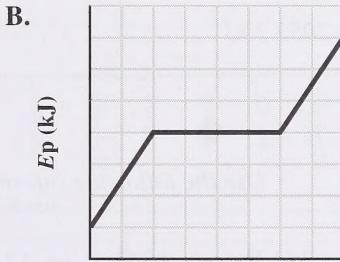
- A. molar fusion and additivity
- B. formation and summation
- C. kinetic and potential energy
- D. calorimetry and combustion

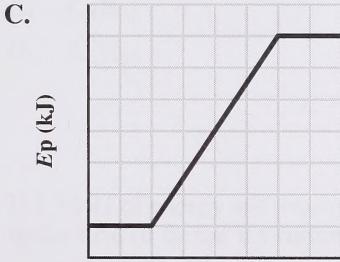
8. A chemical reaction occurs in a calorimeter. The temperature of the calorimeter decreases from 36.50°C to 19.75°C . If a 1350 g sample of water is contained in the calorimeter, what quantity of energy was lost by the water?

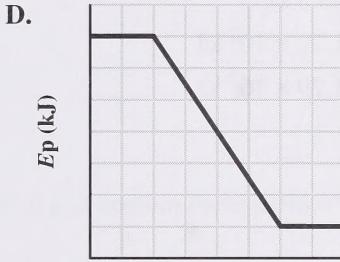
A. 206 kJ
B. 111 kJ
C. 94.7 kJ
D. 22.6 kJ

9. If the products of a chemical reaction have positive heats of formation and the reactants have negative heats of formation, the energy diagram which **best** represents the reaction is

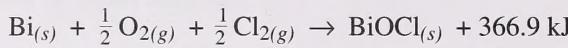
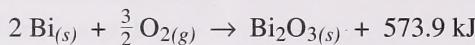
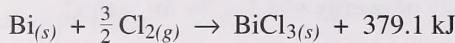
A.  **Reaction co-ordinate**

B.  **Reaction co-ordinate**

C.  **Reaction co-ordinate**

D.  **Reaction co-ordinate**

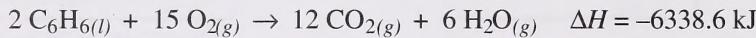
Use the following information to answer question 10.



10. The enthalpy change for $\text{BiCl}_{3(s)} + \text{Bi}_2\text{O}_{3(s)} \rightarrow 3 \text{BiOCl}_{(s)}$ is

- A. +1319.9 kJ
- B. +586.1 kJ
- C. -147.7 kJ
- D. -2053.7 kJ

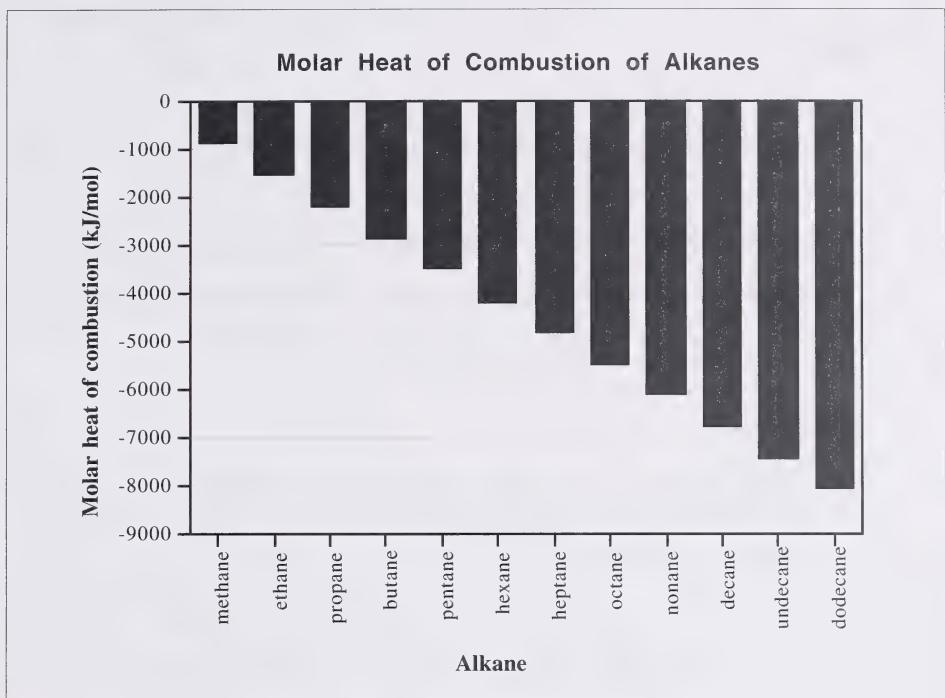
Use the following information to answer question 11.



11. The heat released when a 6.50 g sample of oxygen is consumed is

- A. 0.00 kJ
- B. 85.8 kJ
- C. 1.72×10^2 kJ
- D. 1.29×10^3 kJ

Use the following graph to answer question 12.



12. When 0.50 mol of an alkane undergoes combustion, approximately 4.0×10^3 kJ of heat energy are released. The alkane is most likely

- A. $\text{C}_{12}\text{H}_{26}$
- B. $\text{C}_{10}\text{H}_{22}$
- C. C_8H_{18}
- D. C_6H_{14}

13. If 5.74 kJ of energy are required to melt 50.0 g of sodium metal at 98.0°C, the molar heat of fusion for sodium metal is

- A. +2.64 kJ/mol
- B. +8.71 J/mol
- C. +114.8 kJ/mol
- D. $+1.25 \times 10^5$ kJ/mol

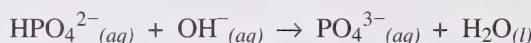
14. Potassium metal is dropped into a beaker of water and the reaction $2 \text{K}_{(s)} + 2 \text{H}_2\text{O}_{(l)} \rightarrow 2 \text{KOH}_{(aq)} + \text{H}_{2(g)}$ occurs. Which statement is **true** for this reaction?

- A. It is an exothermic reaction.
- B. The E°_{net} value is negative.
- C. The reaction is non-spontaneous.
- D. Litmus paper in the reaction beaker turns red.

15. Which household substance has the highest pH?

- A. Vinegar
- B. Ammonia
- C. Lemon juice
- D. Carbonated soft drink

Use the following equation to answer question 16.



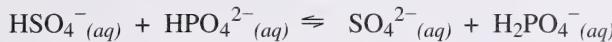
16. A correct statement is that

- A. $\text{HPO}_4^{2-}_{(aq)}$ neutralizes an acid
- B. $\text{PO}_4^{3-}_{(aq)}$ neutralizes water
- C. $\text{HPO}_4^{2-}_{(aq)}$ neutralizes a base
- D. $\text{OH}^-_{(aq)}$ neutralizes $\text{PO}_4^{3-}_{(aq)}$

17. An Arrhenius acid is defined as a substance that increases the concentration of

- A. $\text{OH}^-_{(aq)}$
- B. $\text{H}^+_{(aq)}$
- C. $\text{HCl}_{(aq)}$
- D. $\text{H}_2\text{O}_{(l)}$

Use the following equilibrium to answer question 18.



18. In this equilibrium, the strongest acid and its conjugate base are

- A. $\text{H}_2\text{PO}_4^{-\text{(aq)}}$ and $\text{HPO}_4^{2-\text{(aq)}}$
- B. $\text{HSO}_4^{-\text{(aq)}}$ and $\text{SO}_4^{2-\text{(aq)}}$
- C. $\text{HSO}_4^{-\text{(aq)}}$ and $\text{HPO}_4^{2-\text{(aq)}}$
- D. $\text{SO}_4^{2-\text{(aq)}}$ and $\text{H}_2\text{PO}_4^{-\text{(aq)}}$

19. If four acidic solutions of identical concentration are tested for electrical conductivity, which solution would have the highest electrical conductivity?

- A. $\text{HNO}_3\text{(aq)}$
- B. $\text{HOOCCOOH}\text{(aq)}$
- C. $\text{CH}_3\text{COOH}\text{(aq)}$
- D. $\text{H}_2\text{S}\text{(aq)}$

20. Which ion is **least** capable of acting as either an acid or a base in aqueous solution?

- A. $\text{HS}^{-\text{(aq)}}$
- B. $\text{HCO}_3^{-\text{(aq)}}$
- C. $\text{H}_3\text{O}^{+\text{(aq)}}$
- D. $\text{H}_2\text{PO}_4^{-\text{(aq)}}$

21. As the pH of a solution increases, the

- A. $[\text{OH}^{-\text{(aq)}}]$ decreases
- B. $[\text{H}_3\text{O}^{+\text{(aq)}}]$ decreases
- C. solution becomes more acidic
- D. conductivity must decrease

22. A pH meter probe immersed in a solution displays a reading of 4.21. The $[\text{OH}^{-}_{(aq)}]$ of the solution is

- A. $1.6 \times 10^{-10} \text{ mol/L}$
- B. $6.2 \times 10^{-5} \text{ mol/L}$
- C. $1.6 \times 10^4 \text{ mol/L}$
- D. $6.2 \times 10^9 \text{ mol/L}$

23. The net ionic equation for the reaction that occurs between nitric acid and aqueous potassium hydroxide is

- A. $\text{HNO}_3_{(aq)} + \text{OH}^{-}_{(aq)} \rightarrow \text{NO}_3^{-}_{(aq)} + \text{H}_2\text{O}_{(l)}$
- B. $\text{HNO}_3_{(aq)} + \text{KOH}_{(aq)} \rightarrow \text{KNO}_3_{(aq)} + \text{HOH}_{(l)}$
- C. $\text{K}^{+}_{(aq)} + \text{NO}_3^{-}_{(aq)} \rightarrow \text{KNO}_3_{(aq)}$
- D. $\text{H}_3\text{O}^{+}_{(aq)} + \text{OH}^{-}_{(aq)} \rightarrow 2 \text{H}_2\text{O}_{(l)}$

24. Which reaction favours the reactants?

- A. $\text{H}_3\text{O}^{+}_{(aq)} + \text{OH}^{-}_{(aq)} \rightleftharpoons 2 \text{H}_2\text{O}_{(l)}$
- B. $\text{HCN}_{(aq)} + \text{OH}^{-}_{(aq)} \rightleftharpoons \text{CN}^{-}_{(aq)} + \text{H}_2\text{O}_{(l)}$
- C. $\text{H}_2\text{SO}_4_{(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}_3\text{O}^{+}_{(aq)} + \text{HSO}_4^{-}_{(aq)}$
- D. $\text{HSO}_4^{-}_{(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}_2\text{SO}_4_{(aq)} + \text{OH}^{-}_{(aq)}$

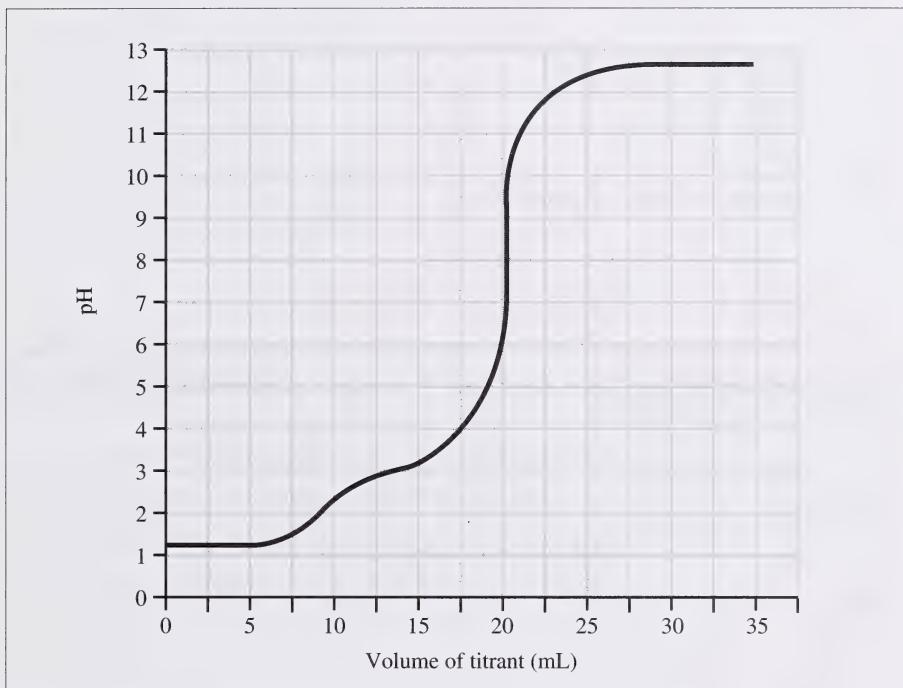
25. The hydroxide ion concentration in pure water at 25.0°C is

- A. $1.00 \times 10^{-14} \text{ mol/L}$
- B. $1.00 \times 10^{-7} \text{ mol/L}$
- C. $1.00 \times 10^7 \text{ mol/L}$
- D. $1.00 \times 10^{14} \text{ mol/L}$

26. A 20.0 mL sample of 0.300 mol/L $\text{NaOH}_{(aq)}$ is required to completely react with 30.0 mL of $\text{HNO}_{2(aq)}$. What was the concentration of the nitrous acid?

- A. 2.56 mol/L
- B. 1.56 mol/L
- C. 0.450 mol/L
- D. 0.200 mol/L

Use the following graph to answer question 27.

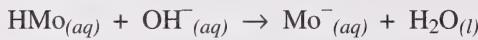
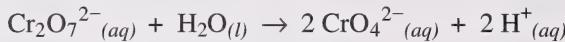
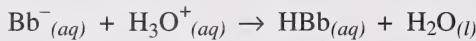


27. The titration **best** represented by the graph is

- A. $\text{HOOCOOH}_{(aq)}$ titrated with $\text{NaOH}_{(aq)}$
- B. $\text{CH}_3\text{COOH}_{(aq)}$ titrated with $\text{Na}_2\text{CO}_3{}_{(aq)}$
- C. $\text{HCl}_{(aq)}$ titrated with $\text{Ba}(\text{OH})_2{}_{(aq)}$
- D. $\text{H}_3\text{O}^+{}_{(aq)}$ titrated with $\text{NH}_4\text{OH}_{(aq)}$

Use the following equations to answer question 28.

All of these reactions favour products:



28. A physical characteristic that all these reactions share is a

- A. yellow colour at the end
- B. transfer of H^+
- C. transfer of e^-
- D. decrease in electrical conductivity

29. For which metal is it **not** possible to experimentally determine the specific heat capacity by placing 75.0 g of the metal, at 90.0°C, into a calorimeter containing 125 g of water at 20.0°C?

- A. $\text{Cu}_{\text{(s)}}$
- B. $\text{Zn}_{\text{(s)}}$
- C. $\text{Na}_{\text{(s)}}$
- D. $\text{Ni}_{\text{(s)}}$

Use the following information to answer question 30.

Consider the following statements:

- I. Titration is the progressive addition of one reagent to another.
- II. Titration involves an acid and a base solution.
- III. The indicator endpoint in a titration should indicate that chemically equivalent amounts have been brought together.
- IV. Titration results in a solution with a pH of 7.0 at the equivalence point.

30. Which statements regarding titration are **always** true?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II, III, and IV

31. Silver compounds, such as $\text{AgNO}_{3(s)}$, can act as strong oxidizing agents because

- A. silver metal can easily be oxidized to silver ions
- B. silver metal can easily be reduced to silver ions
- C. silver ions can easily be oxidized to silver metal
- D. silver ions can easily be reduced to silver metal

32. In the reaction $2 \text{Fe}^{2+}_{(aq)} + \text{Br}_{2(l)} \rightarrow 2 \text{Fe}^{3+}_{(aq)} + 2 \text{Br}^{-}_{(aq)}$, the $\text{Fe}^{2+}_{(aq)}$

- A. gains electrons and undergoes reduction
- B. gains electrons and undergoes oxidation
- C. loses electrons and undergoes reduction
- D. loses electrons and undergoes oxidation

33. An aluminum strip is placed into aqueous copper(II) nitrate. The oxidizing agent for the reaction that occurs is

A. $\text{Al}_{(s)}$
B. $\text{Al}^{3+}_{(aq)}$
C. $\text{Cu}_{(s)}$
D. $\text{Cu}^{2+}_{(aq)}$

34. Which equation is an oxidation-reduction reaction?

A. $\text{HCO}_3^-_{(aq)} + \text{H}_3\text{O}^+_{(aq)} \rightarrow 2 \text{H}_2\text{O}_{(l)} + \text{CO}_{2(g)}$
B. $\text{Zn}_{(s)} + 2 \text{CH}_3\text{COOH}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + 2 \text{CH}_3\text{COO}^-_{(aq)} + \text{H}_2(g)$
C. $\text{Pb}^{2+}_{(aq)} + 2 \text{I}^-_{(aq)} \rightarrow \text{PbI}_{2(s)}$
D. $\text{H}_2\text{SO}_4_{(aq)} \rightarrow \text{H}_2\text{O}_{(l)} + \text{SO}_{3(g)}$

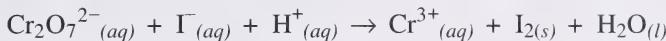
35. The products in the reaction between $\text{Sn}^{2+}_{(aq)}$ and $\text{Cu}^{2+}_{(aq)}$ are

A. $\text{Cu}_{(s)}$ and $\text{Sn}_{(s)}$
B. $\text{Cu}_{(s)}$ and $\text{Sn}^{4+}_{(aq)}$
C. $\text{Cu}^{2+}_{(aq)}$ and $\text{Sn}_{(s)}$
D. $\text{Cu}^{2+}_{(aq)}$ and $\text{Sn}^{2+}_{(aq)}$

36. Nitrogen can react with oxygen to form a variety of industrial byproducts that are released into the air and contribute to air pollution. In which of these compounds does nitrogen have an oxidation number of +3?

A. NO
B. NO_2
C. N_2O
D. N_2O_3

Use the following equation to answer question 37.



37. When this equation is balanced with smallest whole numbers, the coefficient for water is

A. 3
B. 5
C. 7
D. 9

38. The reducing agent capable of converting 1.0 mol/L $\text{Sn}^{4+}(aq)$ ions to $\text{Sn}^{2+}(aq)$ but not capable of converting 1.0 mol/L $\text{Sn}^{2+}(aq)$ to $\text{Sn}_{(s)}$ is

A. $\text{Pb}_{(s)}$
B. $\text{Ni}_{(s)}$
C. $\text{Cu}_{(s)}$
D. $\text{Cr}_{(s)}$

39. When a car battery produces electricity to start the engine, the battery is behaving as

A. an electrolytic cell
B. an electrochemical (voltaic) cell
C. a system in which only oxidation is occurring
D. a system in which only reduction is occurring

40. How many hours would it take to produce 5.40 g of aluminum from molten bauxite using 5.00 A?

A. 1.07 h
B. 2.14 h
C. 3.22 h
D. 6.43 h

Use the following information to answer question 41.

A standard hydrogen half-cell was connected to a $\text{Zn}_{(s)} / \text{Zn}^{2+}_{(aq)}$ half-cell to produce a working electrochemical (voltaic) cell. Put a checkmark () in each box that is **true** for the listed species.

Substance	Species	Anode	Mass of substance changes	Electron donor	Ion that increases in concentration
I.	$\text{Zn}_{(s)}$				
II.	$\text{Zn}^{2+}_{(aq)}$				
III.	$\text{H}^+_{(aq)}$				
IV.	$\text{H}_{2(g)}$				

41. The substance that should have the most checkmarks () is

- A. I
- B. II
- C. III
- D. IV

Use the following information to answer question 42.



42. This equation represents the reaction in an electrochemical cell. The half-cell reaction that occurs at the anode is

- A. $\text{Zn}_{(s)} \rightarrow 2 \text{e}^- + \text{Zn}^{2+}_{(aq)}$
- B. $\text{Zn}^{2+}_{(aq)} + 2 \text{e}^- \rightarrow \text{Zn}_{(s)}$
- C. $\text{Al}_{(s)} \rightarrow 3 \text{e}^- + \text{Al}^{3+}_{(aq)}$
- D. $\text{Al}^{3+}_{(aq)} + 3 \text{e}^- \rightarrow \text{Al}_{(s)}$

You have now completed Part A. Proceed directly to Part B.

Part B: Numerical Response

(7 Questions)

Instructions

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully.
- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**
- Use an HB pencil only.
- If you wish to change an answer, erase **all** traces of your first answer.

Sample Calculation Question and Solution

The mass in kilograms of silver produced when 2.20 mol of silver nitrate reacts with excess copper is _____ kg.

(Record your answer to three digits.)

$$\begin{aligned}\text{mass}_{\text{Ag}} &= 2.20 \text{ mol} \times 107.87 \text{ g/mol} \\ &= 237.314 \text{ g} \\ &= 0.24 \text{ kg (recorded to three digits)}\end{aligned}$$

Record 0.24 on the answer sheet

→

0	.	2	4
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Sample Correct-order Question and Solution

When the following subjects are arranged in alphabetical order, the order is _____.
(Record all four digits.)

- mathematics
- chemistry
- biology
- physics

Answer 3, 2, 1, 4

Record 3214 on the answer sheet

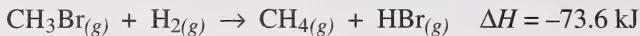
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3	2	1	4
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Start Part B immediately.

Use the following information to answer question 1.



1. The molar heat of formation for methyl bromide, $\text{CH}_3\text{Br}_{(g)}$, is $-$ _____ kJ/mol. (Record your answer to three digits.)

RECORD YOUR ANSWERS ON THE ANSWER SHEET

Use the following key to answer question 2.

- 1 — phase change
- 2 — chemical reaction
- 3 — nuclear reaction

2. Identify the type of change/reaction occurring in the following sources of energy.

Hydrogen fuel: $2 \text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow 2 \text{H}_2\text{O}_{(g)}$ _____.
(Record in first column.)

Steam heating/turbines: $\text{H}_2\text{O}_{(g)} \rightarrow \text{H}_2\text{O}_{(l)}$ _____.
(Record in second column.)

Natural gas heating: $\text{CH}_4_{(g)} + 2 \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(g)}$ _____.
(Record in third column.)

Fission reactor: $^{239}_{94}\text{Pu} + ^1_0\text{n} \rightarrow 3 ^1_0\text{n} + ^{91}_{39}\text{Y} + ^{146}_{55}\text{Cs}$ _____.
(Record in fourth column.)

RECORD YOUR ANSWERS ON THE ANSWER SHEET

3. The pH of a sodium hydroxide solution is 12.000. The mass of $\text{NaOH}_{(s)}$ required to make 4.00 L of this solution is _____ g.
(Record your answer to three digits.)

RECORD YOUR ANSWER FOR QUESTION 3 HERE

4. Solution A has a pH of 3.444 and solution B has a pH of 2.143. The number of times more concentrated the hydronium ion is in solution B than in solution A is _____.
(Record your answer to three digits.)

RECORD YOUR ANSWER FOR QUESTION 4 HERE

Use the following information to answer question 5.

1 - 0.10 mol/L $\text{KOH}_{(aq)}$
2 - 0.10 mol/L $\text{H}_2\text{SO}_4_{(aq)}$
3 - 0.10 mol/L $\text{Ba}(\text{OH})_2_{(aq)}$
4 - 0.10 mol/L $\text{HCl}_{(aq)}$

5. When these solutions are arranged in order of increasing pH, their order is _____.

RECORD YOUR ANSWER FOR QUESTION 5 HERE

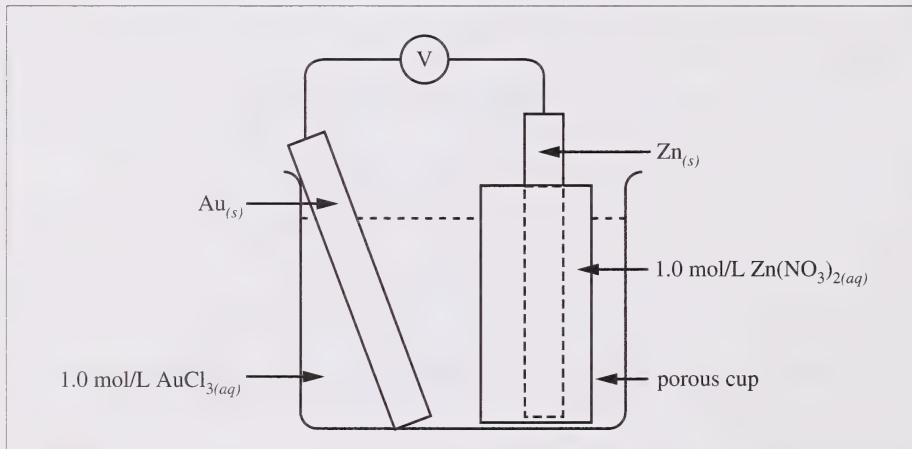
Use the following table to answer question 6.

Metallic ions	5 $W_{(aq)}$	6 $X_{(s)}$	7 $Y_{(s)}$	8 $Z_{(s)}$
1 $W^{2+}_{(aq)}$	--	R	R	R
2 $X^+_{(aq)}$	NR	--	R	NR
3 $Y^{2+}_{(aq)}$	NR	NR	--	NR
4 $Z^+_{(aq)}$	NR	R	R	--

R — spontaneous reaction
NR — no reaction
-- not tested

6. When the reducing agents are arranged in order of increasing strength, their order is _____.

Use the following diagram of an electrochemical cell to answer question 7.



7. The reading on the voltmeter is _____ V.
(Record your answer to three digits.)

You have now completed Part B. Proceed directly to Part C.

Part C: Written Response

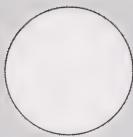
(3 Questions)

Instructions

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully.
- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers **must show all** pertinent explanations, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences for a written response, and correct units and significant digits for a numerical response.

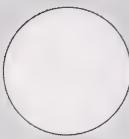
Note: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

Start Part C immediately.



1. A student pipeted a 25.0 mL sample of $\text{Sn}^{2+}_{(aq)}$ from a 500 mL volumetric flask. The sample was then oxidized using 28.4 mL of 0.260 mol/L acidic $\text{Cr}_2\text{O}_7^{2-}_{(aq)}$ solution from a glass buret.
 - a. Write the net ionic balanced equation and determine the standard cell potential for this reaction.
 - b. Determine the mass of $\text{Sn}(\text{NO}_3)_{2(s)}$ that was used to make 500 mL of the $\text{Sn}^{2+}_{(aq)}$ solution.
 - c. What two properties of acidic dichromate make it a good choice as an oxidizing agent to use in redox titrations? Explain why.

2. As a prelab assignment, you are required to develop a procedure to determine the molar mass of an unidentified sample. You are told that the sample is a solid strong base and that it has the general formula $\text{XOH}_{(s)}$. Write a step-by-step **experimental procedure** that you or anyone else could follow to obtain the essential data necessary to determine the molar mass of the sample. You have access to a lab containing all equipment normally available in a high school lab, a supply of distilled water, standardized 0.125 mol/L $\text{HCl}_{(aq)}$, and all the indicators listed in your data booklet.



3. Campers sometimes make temporary showers by using a sealed black plastic container. The campers fill the container with water from a nearby stream or lake and then suspend it in direct sunlight so that it will absorb heat. This is normally done in the morning so that the “shower” can absorb heat all day.

a. If the container holds 50.0 L of water and the water obtained from the stream has an initial temperature of 11.2°C , how much energy is absorbed if the final water temperature is 39.0°C ?

b. If the campers had used propane instead of sunlight, what mass of propane would have to be burned, to gaseous products, to provide the same amount of energy as that absorbed from the sun to heat the 50.0 L of water?

*You have now completed the examination.
If you have time, you may wish to check your answers.*

No marks will be given for work done on this page.

Fold and tear along perforation.

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